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Ludwig et al.

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(54) **ROOM CLOUD ENVIRONMENT FOR CONFERENCING**

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H04N 7/15 (2006.01)
H04L 29/06 (2006.01)

(52) **U.S. Cl.**
CPC ***H04L 65/403*** (2013.01); ***H04N 7/15*** (2013.01)

(58) **Field of Classification Search**
CPC H04N 7/15; H04N 7/152; H04N 7/14; H04N 7/142
USPC 348/14.01–14.16
See application file for complete search history.

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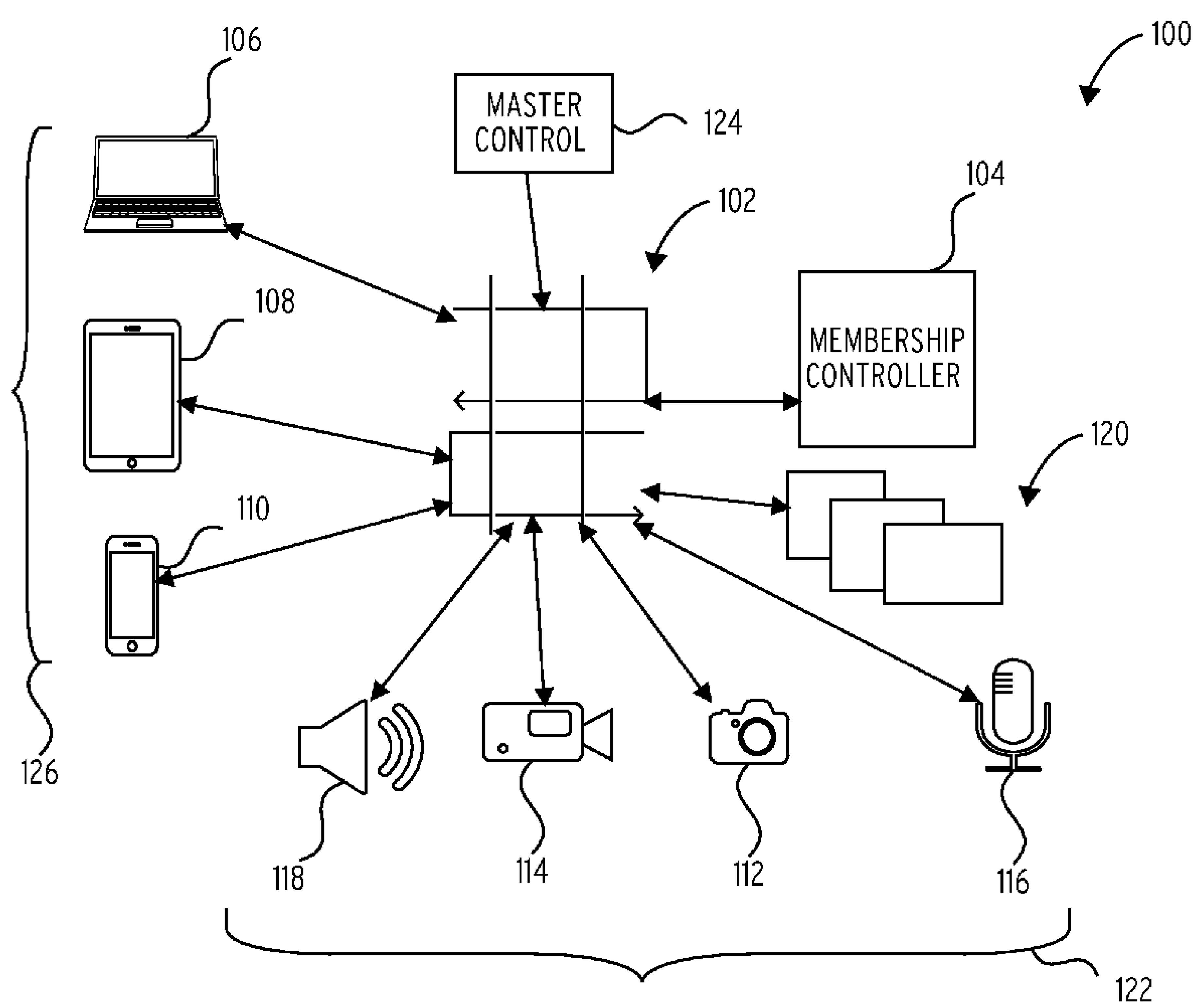
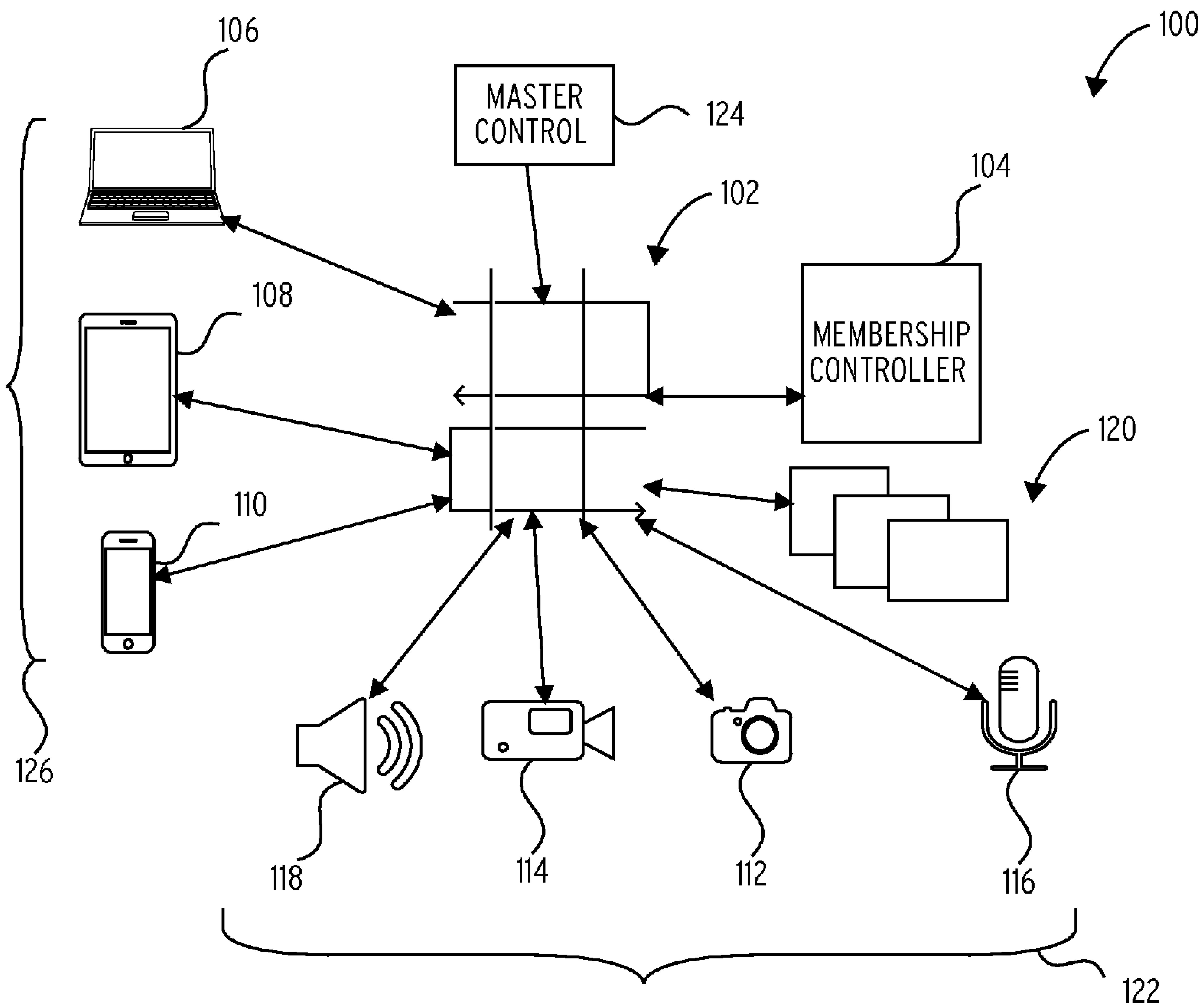
(57) **ABSTRACT**

A room conferencing system includes a hub with a plurality of sensor nodes, each sensor node including a sensor node camera and a sensor node processor. A master controller is operable to establish a plurality of named queues, each of the named queues associated with a proximate physical object in an area comprising the hub and detectable by the sensor node camera. Each sensor node operable to cause the sensor node processor to identify a viewed physical object in a feed from the sensor node camera, and associate the viewed physical object with one of the named queues.

7 Claims, 8 Drawing Sheets





100
106
MASTER CONTROL
124
102
104
108
MEMBERSHIP CONTROLLER
120
110
126
118
114
112
116
122

FIG. 1

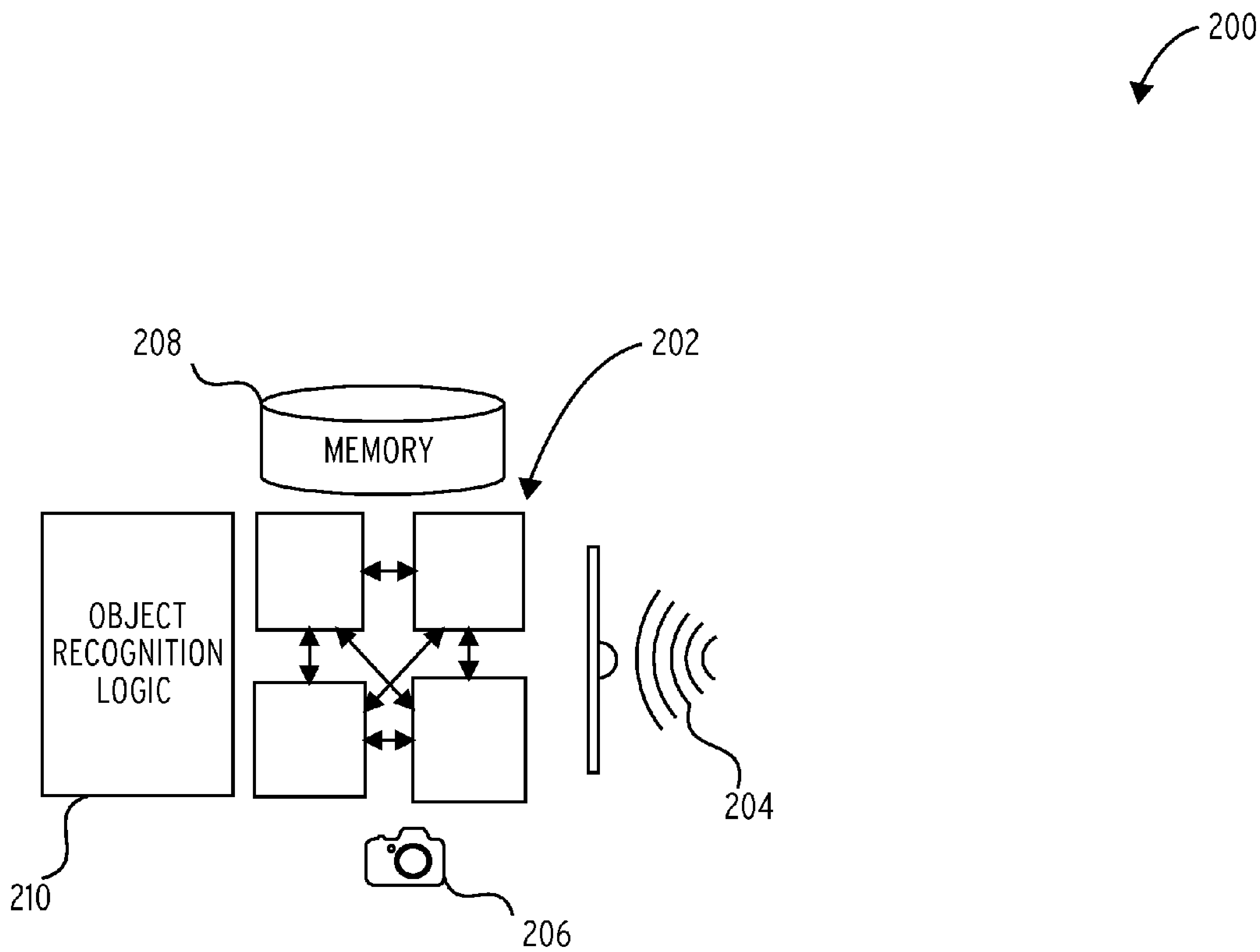


FIG. 2

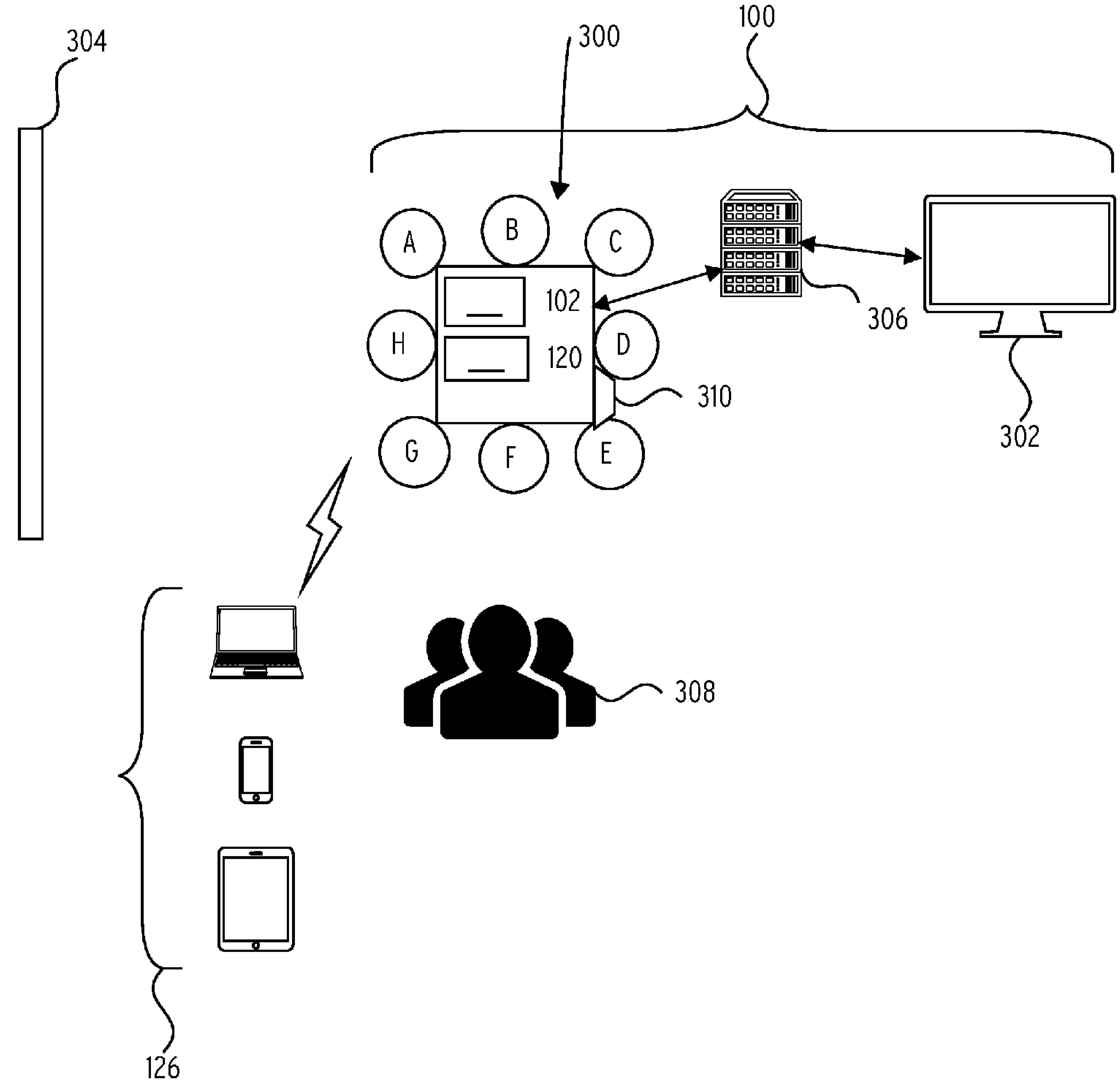


FIG. 3

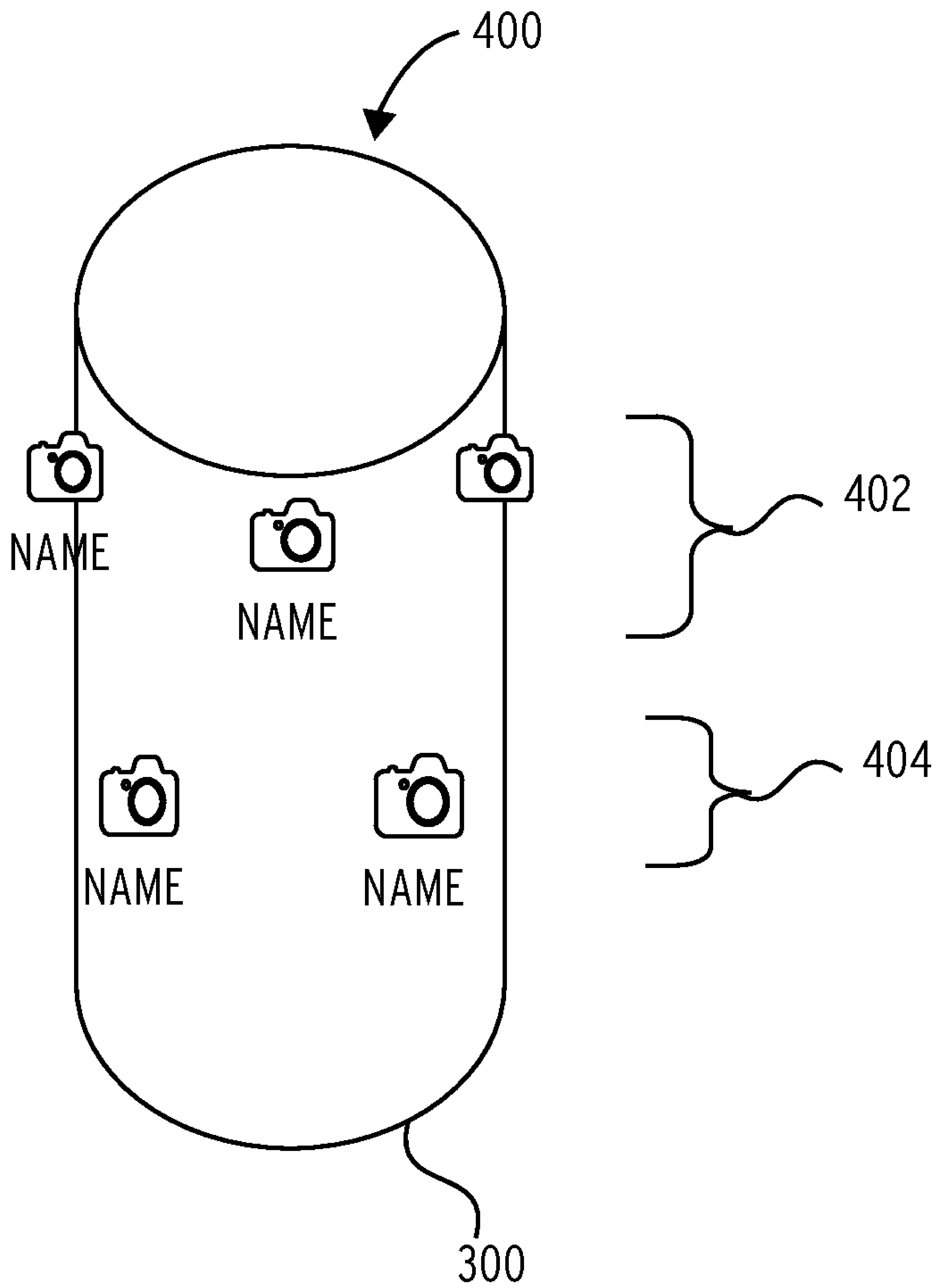


FIG. 4

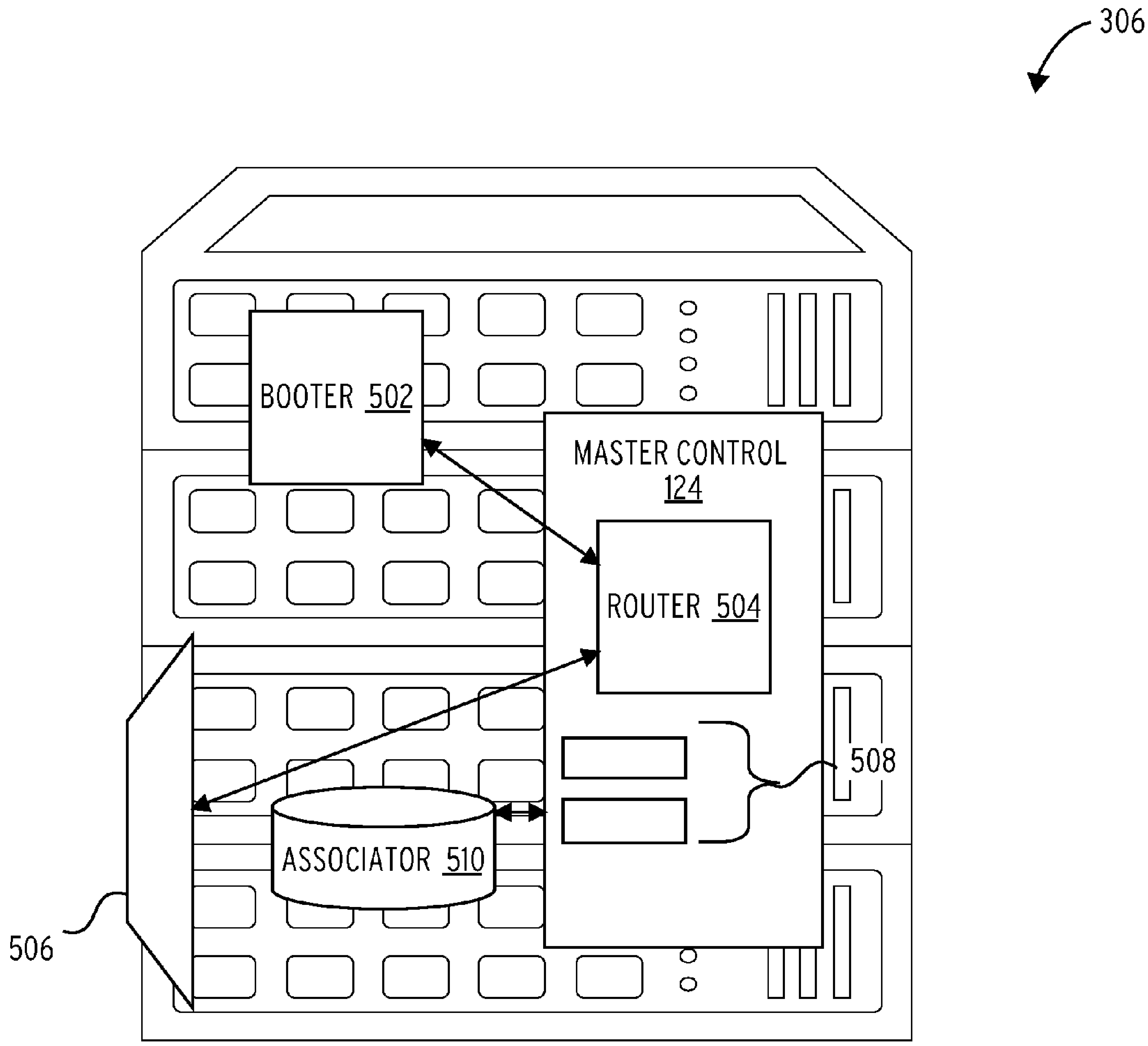

306
BOOTER 502
MASTER CONTROL
124
ROUTER 504
508
ASSOCIATOR 510
506

FIG. 5

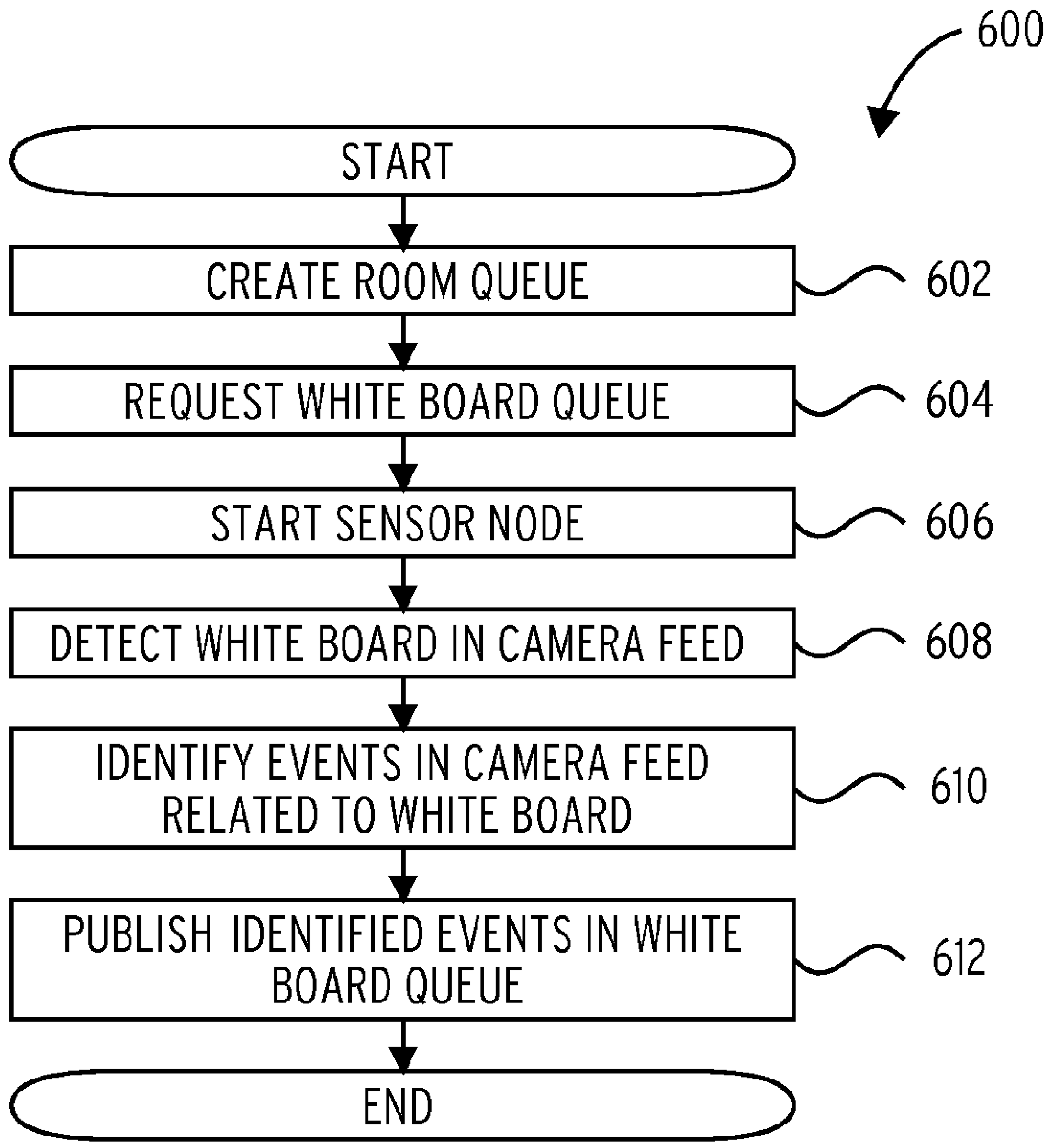

600
START
CREATE ROOM QUEUE
602
REQUEST WHITE BOARD QUEUE
604
START SENSOR NODE
606
DETECT WHITE BOARD IN CAMERA FEED
608
IDENTIFY EVENTS IN CAMERA FEED RELATED TO WHITE BOARD
610
PUBLISH IDENTIFIED EVENTS IN WHITE BOARD QUEUE
612
END

FIG. 6

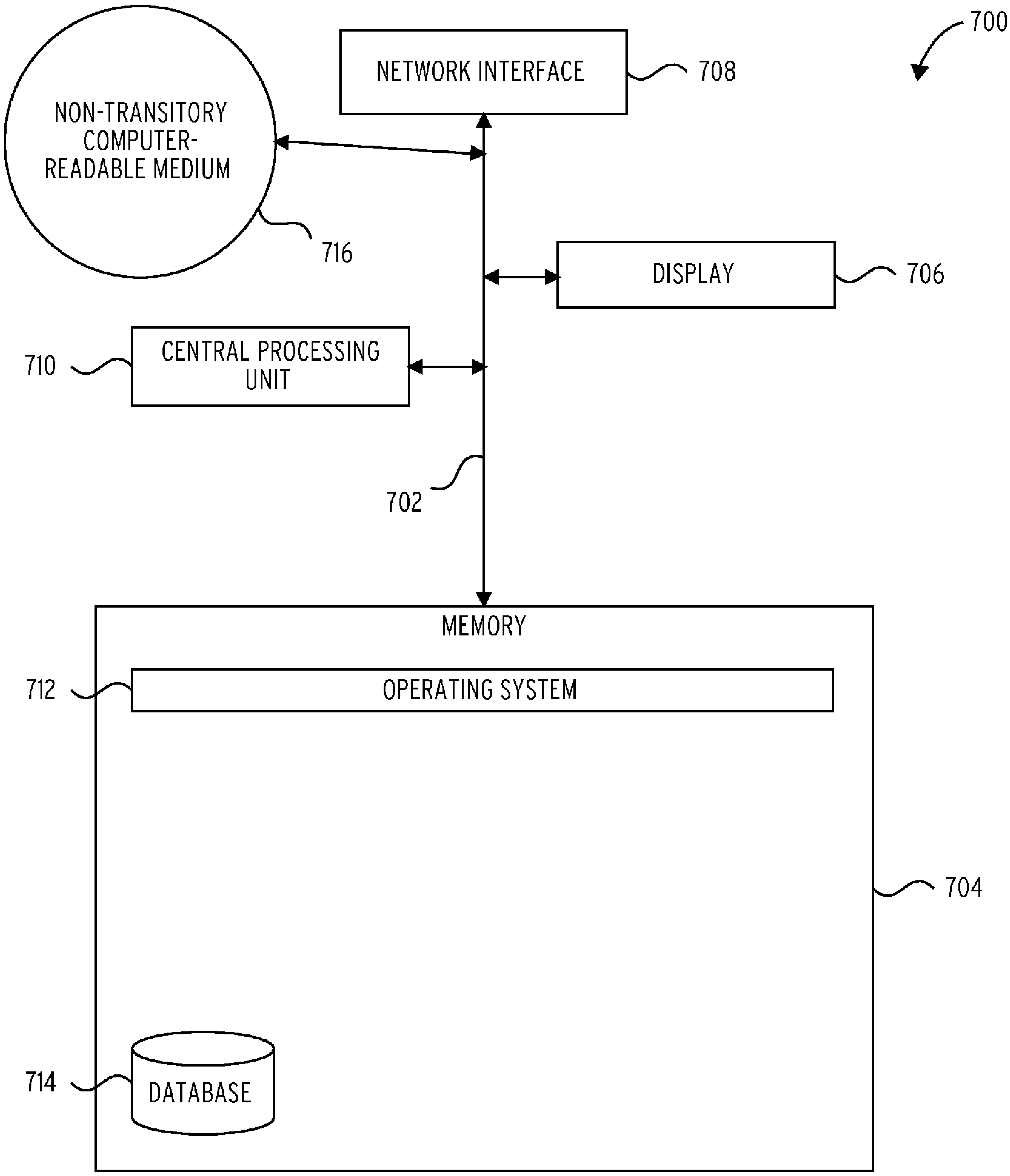

700
NON-TRANSITORY COMPUTER-READABLE MEDIUM
716
NETWORK INTERFACE
708
DISPLAY
706
CENTRAL PROCESSING UNIT
710
702
MEMORY
OPERATING SYSTEM
712
704
DATABASE
714

FIG. 7

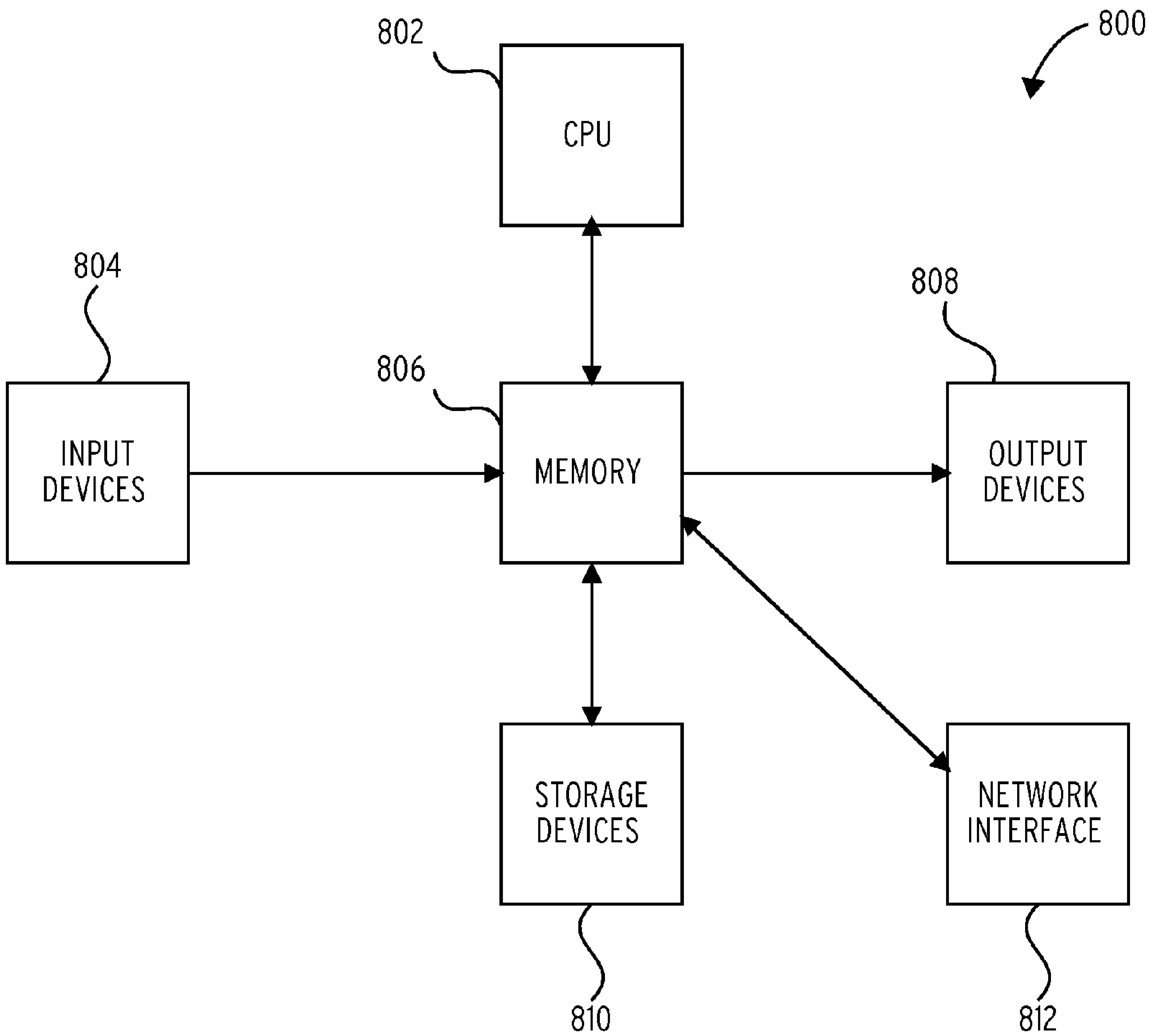

800
802
CPU
804
INPUT DEVICES
806
MEMORY
808
OUTPUT DEVICES
STORAGE DEVICES
810
NETWORK INTERFACE
812

FIG. 8

ROOM CLOUD ENVIRONMENT FOR CONFERENCING

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority and benefit under 35 u.s.c. 119 to U.S. application Ser. No. 62/013,623, filed on Jun. 18, 2014, which is incorporated herein by reference in its entirety.

BACKGROUND

Today, you can either have high scale and robustness in an enterprise cloud computing or you can have massive sensor data and location information in a handheld device. But, no system combines the best of Internet-scale cloud computing with the sensor rich mobile devices that live in the millions of rooms in every office building and in every home. If such a system existed it would dramatically improve the management of these systems, the security and enable a large class of room-focused applications.

BRIEF SUMMARY

In some embodiments, a room conferencing system may include a hub, a master controller operable to establish a group of named queues, and/or each sensor node. The hub may include a group of sensor nodes, each sensor node may include a sensor node camera and a sensor node processor.

In some embodiments, each of the named queues is associated with a proximate physical object in an area that includes the hub and which is detectable by the sensor node camera.

In some embodiments, the room conferencing system includes logic to identify a viewed physical object in a feed from the sensor node camera. In some embodiments, the system may associate the viewed physical object with one of the named queues.

In some embodiments, such a room conferencing system may further include the master controller operable to establish a master queue. This master queue may include a description of the proximate physical object.

In some embodiments, such a room conferencing system may further include the group of sensor nodes arranged in a group of rings around a perimeter of the hub.

In some embodiments, each ring may include exactly four sensor nodes.

In some embodiments, each ring may include exactly eight sensor nodes.

The sensors in one particular ring may be both vertically and horizontally offset from sensors in a ring immediately above the particular ring.

In some embodiments, the sensors in one particular ring may be both vertically and horizontally offset from sensors in a ring immediately above the particular ring and sensors in a ring immediately below the particular ring.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

To easily identify the discussion of any particular element or act, the most significant digit or digits in a reference number refer to the figure number in which that element is first introduced.

FIG. **1** illustrates an embodiment of a room cloud system **100**.

FIG. **2** illustrates an embodiment of a sensor node **200**.

FIG. **3** illustrates an embodiment of a room hub **300** utilized in a room cloud system **100**.

FIG. **4** is a front view illustration of a room hub utilizing four cameras per ring **400**.

FIG. **5** illustrates an embodiment of a server **306**.

FIG. **6** illustrates an embodiment of a process of operating a room conference system **600**.

FIG. **7** illustrates a server **700** in accordance with one embodiment.

FIG. **8** illustrates an embodiment of a digital apparatus **800** to implement components and process steps of the system described herein.

DETAILED DESCRIPTION

Description

Embodiments of a device system are disclosed that utilizes architectural features of Internet-scale cloud computing on a mobile-oriented, sensor-rich environment in a single room of the home or office. The system applies Internet-scale robustness at the hardware level so that individual components in a room cloud device may fail and spare processors can take over. It constantly checks itself and ensures that when a hardware device fails or software fails it recovers without user intervention. The system utilizes bus interconnects and failure-over systems that is much less expensive than data center systems yet offers data center advantages that mobile and small computers lack today.

The system may utilize public key encryption schemes, fault tolerance, re-configurability, and administration applied to mobile devices and computers at the room scale (a "room cloud"). The system manages new devices entering and leaving the "room cloud". The system manipulates real-time sensor data and communicates it in a reliable way enabling map/reduce and parallel computing applications. The system utilizes reliable message queues rather than publishing to a URL or relying on flat tables, and executes on a private network with high consistency and redundancy.

Some embodiments utilize a map/reduce paradigm modified for small-scale networks. Rather than fixed nodes that have roles, every processor in the room cloud may participate in any map/reduce operation. For example if a camera element isn't committed with capturing video, it may be utilized to assist with post-processing data from other sensors. At the applications level, a new class of application is enabled because the entire "room" may be programmed. Computation is distributed. When intensive image processing is required, the operating system identifies one or more GPU element and allocates the processing accordingly. If two sensors are measuring or recording the same object, their outputs may be correlated.

DRAWINGS

FIG. **1** illustrates an embodiment of a room cloud system **100**. The room cloud system **100** comprises an intelligent bus fabric **102**, a master control **124**, a membership controller **104**, various sensors and transducers **122** (e.g., speaker **118**, video camera **114**, still frame camera **112**, and microphone **116**), and a GPU pool **120**.

Various mobile devices (e.g., mobile computer **106**, tablet device **108**, and mobile phone **110**) interface on a temporary basis with the room cloud system **100** and communicate with one another and with the system's sensors and transducers **122** via the bus fabric **102**. Under control of the master control **124** the GPU pool **120** processes measurements and recorded data from the sensors and transducers **122** using secure message queues. Some elements of the GPU pool **120** may be distributed among the sensors and transducers **122**. The GPU pool **120** may operate semi-autonomously from the master control **124**.

The membership controller **104** authenticates, joins, and un-joins various end user devices **126** that enter and leave the room cloud system **100**.

FIG. **2** illustrates an embodiment of a sensor node **200**. The sensor node **200** comprises a processor array **202**, a memory **208**, a network communication interface **204**, object recognition logic **210**, and one or more camera **206**. The sensor node **200** may further comprise additional types of sensors and transducers **122** not illustrated in this example. For example, some embodiments of the sensor node **200** may comprise speakers, microphones, temperature sensors, a GPS (Global Positioning System) interface, a magnetometer, IR motion sensor, or an accelerometer.

Multiple of the sensor node **200** may be arranged into a "room hub", and one or more room hubs may be integrated via the bus fabric **102** with various mobile devices (see FIG. **1**) and room displays to form a room cloud system **100**.

The network communication interface **204** may comprise a WiFi interface, an Ethernet interface, or other network communication technology. Room hubs may be placed on table top, mounted to ceilings, walls, mounted next to a flat screen or otherwise located in a room. Within the room hub, multiple sensor node **200** devices form a redundant array of processing elements with a bus based on serial protocols such as USB or Thunderbolt. One or more of the sensor node **200** may utilize USB charging. Each sensor node **200** of the room hub comprises its own processor array **202** and memory **208** and operates independently of the other sensor nodes in the room hub. The bus fabric **102** is hot-swappable, so a sensor node **200** may be replaced or removed or added without interrupting operation of the room cloud system **100**.

When a sensor node **200** is brought "online" (turned on or added into the room cloud system **100**), it may communicate a manifest of its components to the master control **124**. The master control **124** may then allocate data processing and other tasks to the sensor node **200**.

The memory **208** may comprise RAM, ROM, flash, and other types of read-write memory technology. The memory **208** may also comprise a high-capacity storage such as a hard drive or solid-state drive. The processor array **202** may comprise one (typically, more than one) a high performance processor (e.g., Intel class vs ARM) that comprises a GPU (graphics processing unit). The master control **124** includes the processor array **202** in the GPU pool **120** of the room cloud system **100**. The processor array **202** may be utilized by the object recognition logic **210** for rendering and image analysis, for example to recognize faces, whiteboards, or an interactive display **302**.

FIG. **3** illustrates an embodiment of a room hub **300** utilized in a room cloud system **100**. The room hub **300** comprises elements of the room cloud system **100** including all or part of the bus fabric **102** and GPU pool **120**. The room hub **300** may interface to a server **306** that comprises the master control **124** and membership controller **104**. The server **306** may interface to an interactive display **302** visible to all of the meeting participants **308** and may be monitored for activity (e.g., user actions and changes to the display surface) by the room hub **300**. A whiteboard **304** may also be visible to the meeting participants **308** and may be monitored for activity by the room hub **300**.

In one embodiment the room hub **300** comprises 8-16 sensor node **200** devices. These may comprise 6-12 normal focus cameras with 120 degree field of view (FOV) to provide a high resolution surround image in a redundant configuration so that several of the sensor node **200** devices can fail and still maintain a 360 degree view as well as allowing distance detection for cameras that view the same object. In some embodiments the **200** devices vertically align the cameras to provide more redundancy. The sensor node **200** array may be designed to be maximally redundant by arranging them in a honeycomb pattern. The cameras may operate in HDR and super-resolution mode, operating with different exposures to handle the wide exposure latitudes in many rooms. In one embodiment 2-4 wide angle cameras provide a 180 degree view with IR (infrared) sensing to detect motion and other events in the room, and to operate at a lower power consumption mode. In some embodiments one or more sensor node **200** devices comprise laser detection or other precise 3D imaging technologies for distance analysis as well as IR sensing for low light.

The room hub **300** may comprise a location/orientation sensor **310** that enables the room hub **300** to be positioned in any orientation. Absolute orientation and position may be determined using accelerometers, magnetometers, and/or GPS.

The room hub **300** may utilize sensor node **200** devices forming a redundant array of inexpensive cameras to increase fault tolerance and to also increase resolution, exposure latitude, distance calculation and other features. In one embodiment a "top" (highest elevation) of the room hub **300** comprises a 4-ring of wide angle lens sensor node **200** devices, providing a failover limit of one (1). Any camera can fail and the system continues to operate a camera in low definition with wide angle view. In one embodiment the room hub **300** comprises a stacked pair of 4-ring sensor node **200** devices. Any particular point in a **360** view of the room is covered by three cameras. This gives us stereo parallax and also **1**-camera redundancy to stereo vision.

The described arrangements of the sensor node **200** devices in the room hub **300** provides super-resolution, real-time HDR. With variable focus cameras the system may enable stacked focus. For even more resolution the system can trade stereo vision and redundancy for resolution. The more rings of sensor node **200** devices that are provided on the room hub **300**, the more capabilities may be enabled. So we can use the same trick and the software gets simpler. The room cloud system **100** may scale to utilize very large camera arrays. In one embodiment one or more ring of sensor node **200** devices comprises cameras with zoom lenses, each providing a 30 degree field of view.

FIG. **4** is a front view illustration of a room hub utilizing four cameras per ring **400**.

In the room hub utilizing four cameras per ring **400**, N=4, and each of two rings of four camera devices (e.g., sensor node **200** device) are offset from one another horizontally around a periphery of the room hub **300**. An upper ring **402** has a first peripheral layout, and a lower ring **404** has a second horizontal layout horizontally and vertically offset from the first horizontal layout. Thus if the upper ring **402** has sensor node **200** devices at 0 degrees, 90, 180 and 270, then the lower ring **404** has sensor node **200** devices offset at 0+45, 90+45, 180+45 and 270+45 (for example). A third ring, if present, may be offset from both of the upper ring **402** and the lower ring **404**, for example with sensor node **200** devices at 22.5 offsets. A fourth ring, if present, might have sensor node **200** offset at 22.5+45. Thus for any given point in the room, the camera (or other sensor) coverage overlaps, providing redundancy as well as allowing multiple camera features such as HDR (high definition resolution).

In one embodiment, cameras that overlap record different exposures providing wider latitude for focus stacking. Focus stacking (also known as focal plane merging and z-stacking or focus blending) is a digital image processing technique which combines multiple images taken at different focus distances to give a resulting image with a greater depth of field (DOF) than any of the individual source images.

In some embodiments the offset rings upper ring **402** and lower ring **404** are utilized to provide stereo and distance calculations. The processor array **202** devices in each ring may operate cameras at different frame rates and different resolutions. Wide angle lenses may be operated at slow motion rates and consume less power on a per unit basis than other cameras. The wide angle cameras may be operated as "cones" for low-power visual monitoring.

Higher frame rate rings may be turned off periodically enabling the room hub utilizing four cameras per ring **400** to efficiently manage power by changing the resolution and frame rates of cameras that are turned on. Each of the sensor node **200** devices may be periodically "rebooted" (full power on reset) in a sequence that advantageously utilizes redundancy of view coverage at all times. Counterintuitively, these periodic full resets of the sensor node **200** devices may actually increase system availability and coverage.

illustrates an embodiment of a server **306**. Although illustrated in the provided examples as a separate component/device, in some embodiments the server **306** may be implemented in each of the room hub **300** devices.

When a room hub **300** initiates operation, it communicates with the network interface **506** of the server **306** to interface with the router **504**. The router **504** handles DHCP and other requests from the sensor node **200** devices of the room hub **300** and then boots them from its own cache via operation of the booter **502**. The master control **124** operates the router **504** to provide a set of real-world object associated queues **508** that are published to all sensor node **200** devices in the system and also potentially to other devices in the room cloud system **100** such as the interactive display **302**.

From an application perspective, the real-world object associated queues **508** are not "feeds" in the traditional sense of a data stream from a source sensor device such as a video camera. Rather, the real-world object associated queues **508** are associated with named program objects identified by the object recognition logic **210** of the various sensor node **200** devices in cooperation with the master control **124** and object pattern associator **510** (each of which may be components of the room hub **300**), or named explicitly by users of the room cloud system **100** (e.g., meeting participants **308**).

The sensor node **200** devices may post information to these message queues and they may also receive commands from control queues. This enables the room cloud system **100** with robust operation and allows sensor node **200** devices to cleanly fail over because the queue names are published throughout the room cloud system **100** and fail over elements may subscribe to the queues.

A public and subscribe model may be utilized enabling patterns such as router/dealer in systems such as Zeromq for redundancy and high performance. There may be multiple room hub **300** devices in the same room and they may interoperate to provide overlapping field of view and sensing information using the described queuing system.

Room hub **300** devices may be in physically distinct locations from one another to support distributed meetings while interoperating over the Internet or a LAN (local area network) or WAN (wide area network). The room hub **300** devices may utilize a HTTP (hypertext transfer protocol)/SSL (secure sockets layer) web socket to each other for security and easy scale across a variety of network systems.

FIG. **6** illustrates an embodiment of a process of operating a room conference system **600**. Applications listen and consume named real-world object associated queues **508**, process the contents and then push results onto other queues. The process of operating a room conference system **600** embodiment illustrates how the system might track white board activity.

The master control **124** interoperates with the router **504** to establish a "Room Queue" at block **602**. This is a queue utilized to configure requests for sensor data from applications and sensor node **200** devices. When a process want to track the "white board" object in the room (a physical whiteboard **304** object), at block **604** publishes a request to the Room Queue requesting the location of the "white board" in room coordinates (parametrically, an object that is right now on the side wall, it is white, etc.) and indicating the events from this object for which to receive notifications (e.g., a new annotation, or changing to the "white board" as the object represented on the interactive display **302**). Unlike conventional techniques, this embodiment of operation does not identify the source process or device for messages in the queue, nor is a graph of interaction generated a priori. The room cloud system **100** may be a fundamentally unreliable system, with unpredictable participants or available sensor node **200** devices.

The system establishes a "white board queue" where events related to the white board are published.

When a sensor node **200** device is started at block **606** (e.g., turned on or reset), it subscribes to the room request queue. It then receives messages from the queue representing requests, and determines if it can fulfill those requests. Each camera takes in these requests and maintains a table of which object queues are open and require data.

At block **608** the sensor node **200** detects the white board object in its camera feed, based on the parametric description in the room queue, and begins identifying events related to the white board at block **610**. These events are published in the white board queue at block **612** for consumption/listening by processes or other sensor node **200** devices interested in white board events.

Queues are associated with physical things in the room. There may exist a white board queue, an interactive display queue, a "John Smith" queue that tracks actions by a participant identified by that name, there may exist an "Unknown Subject that just entered the room queue", and so on.

Cameras with a view of the white board publish updates to the "white board queue". There may be no notion of constant frames per second. Processors subscribe to these object queues. They wait for input, they don't know where the input is coming from or if they get everything and some of the information is definitely wrong. However the object queue provides a single place for processes to wait on events about a particular proximate physical object, regardless of the source of those events.

In one embodiment each sensor node **200** measures its relative attitude (e.g., orientation to the ground and magnetic north) to determine which direction its associated camera device is facing. Each sensor node **200** device is to some extent autonomous, comprising a processor, memory, and resident object processing logic. The queues themselves may be redundant and configured to enable models such as router/dealer.

In one embodiment multiple room hubs interoperate to create a distributed meeting room environment. A master queue started by the first room hub to start up. This is detected by other room hubs which all subscribe. If the master goes down, it is just another publisher because fundamentally a queue lives in the network as a TCP/IP address with a socket and fail-over works as it does with all TCP/IP devices. Multi room conferences are enabled by applications that can subscribe to queues from room hubs in different rooms. Storing information ("conference logging") is enabled by reading information from a queue and writing it into persistent storage. This enables storage of information both in the cloud and in the room itself.

For security, messages in a queue may be encrypted with the subject (e.g., the proximate physical object represented in the queue) key and owner key so that only processors with the right key can read and interpret the messages. This provides an efficient means to implement privacy-enhanced processing.

A text data logging process may listen to queues and creates its own queues with strictly textual data in it. These may be aggregated as well in reduce phases. Requests for information can go to either dedicated logging queues or to the general room queue.

Facial recognition may be implemented by publishing requests to identify faces encoded in queues to a cloud computing infrastructure, for example one implementing Large Scale Neural Networks and Artificial Intelligence.

FIG. **7** illustrates several components of an exemplary server **700** in accordance with one embodiment. In various embodiments, server **700** may include a desktop PC, server, workstation, mobile phone, laptop, tablet, set-top box, appliance, or other computing device that is capable of performing operations such as those described herein. In some embodiments, server **700** may include many more components than those shown in FIG. **7**. However, it is not necessary that all of these generally conventional components be shown in order to disclose an illustrative embodiment. Collectively, the various tangible components or a subset of the tangible components may be referred to herein as "logic" configured or adapted in a particular way, for example as logic configured or adapted with particular software or firmware.

In various embodiments, server **700** may comprise one or more physical and/or logical devices that collectively provide the functionalities described herein. In some embodiments, server **700** may comprise one or more replicated and/or distributed physical or logical devices.

In some embodiments, server **700** may comprise one or more computing resources provisioned from a "cloud computing" provider, for example, Amazon Elastic Compute Cloud ("Amazon EC2"), provided by Amazon.com, Inc. of Seattle, Wash.; Sun Cloud Compute Utility, provided by Sun Microsystems, Inc. of Santa Clara, Calif.; Windows Azure, provided by Microsoft Corporation of Redmond, Wash., and the like.

Server **700** includes a bus **702** interconnecting several components including a network interface **708**, a display **706**, a central processing unit **710**, and a memory **704**.

Memory **704** generally comprises a random access memory ("RAM") and permanent non-transitory mass storage device, such as a hard disk drive or solid-state drive. Memory **704** stores an operating system **712**.

These and other software components may be loaded into memory **704** of server **700** using a drive mechanism (not shown) associated with a non-transitory computer-readable medium **716**, such as a floppy disc, tape, DVD/CD-ROM drive, memory card, or the like.

Memory **704** also includes database **714**. In some embodiments, server **200** (deleted) may communicate with database **714** via network interface **708**, a storage area network ("SAN"), a high-speed serial bus, and/or via the other suitable communication technology.

In some embodiments, database **714** may comprise one or more storage resources provisioned from a "cloud storage" provider, for example, Amazon Simple Storage Service ("Amazon S3"), provided by Amazon.com, Inc. of Seattle, Wash., Google Cloud Storage, provided by Google, Inc. of Mountain View, Calif., and the like.

FIG. **8** illustrates an embodiment of a digital apparatus **800** to implement components and process steps of the system described herein, for example to implement a sensor node **200** or a room hub **300**.

Input devices **804** comprise transducers that convert physical phenomenon into machine internal signals, typically electrical, optical or magnetic signals. Signals may also be wireless in the form of electromagnetic radiation in the radio frequency (RF) range but also potentially in the infrared or optical range. Examples of input devices **804** are keyboards which respond to touch or physical pressure from an object or proximity of an object to a surface, mice which respond to motion through space or across a plane, microphones which convert vibrations in the medium (typically air) into device signals, scanners which convert optical patterns on two or three dimensional objects into device signals. The signals from the input devices **804** are provided via various machine signal conductors (e.g., busses or network interfaces) and circuits to memory **806**.

The memory **806** is typically what is known as a first or second level memory device, providing for storage (via configuration of matter or states of matter) of signals received from the input devices **804**, instructions and information for controlling operation of the CPU **802**, and signals from storage devices **810**.

Information stored in the memory **806** is typically directly accessible to the CPU **802** of the device. Signals input to the device cause the reconfiguration of the internal material/energy state of the memory **806**, creating in essence a new machine configuration, influencing the behavior of the digital apparatus **800** by affecting the behavior of the CPU **802** with control signals (instructions) and data provided in conjunction with the control signals.

Second or third level storage devices **810** may provide a slower but higher capacity machine memory capability. Examples of storage devices **810** are hard disks, optical disks, large capacity flash memories or other non-volatile memory technologies, and magnetic memories.

The CPU **802** may cause the configuration of the memory **806** to be altered by signals in storage devices **810**. In other words, the CPU **802** may cause data and instructions to be read from storage devices **810** in the memory **806** from which may then influence the operations of CPU **802** as instructions and data signals, and from which it may also be provided to the output devices **808**. The CPU **802** may alter the content of the memory **806** by signaling to a machine interface of memory **806** to alter the internal configuration, and then converted signals to the storage devices **810** to alter its material internal configuration. In other words, data and instructions may be backed up from memory **806**, which is often volatile, to storage devices **810**, which are often non-volatile.

Output devices **808** are transducers which convert signals received from the memory **806** into physical phenomenon such as vibrations in the air, or patterns of light on a machine display, or vibrations (i.e., haptic devices) or patterns of ink or other materials (i.e., printers and 3-D printers).

The network interface **812** receives signals from the memory **806** and converts them into electrical, optical, or wireless signals to other machines, typically via a machine network. The network interface **812** also receives signals from the machine network and converts them into electrical, optical, or wireless signals to the memory **806**.

References to "one embodiment" or "an embodiment" do not necessarily refer to the same embodiment, although they may. Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise," "comprising," and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to." Words using the singular or plural number also include the plural or singular number respectively, unless expressly limited to a single one or multiple ones. Additionally, the words "herein," "above," "below" and words of similar import, when used in this application, refer to this application as a whole and not to any particular portions of this application. When the claims use the word "or" in reference to a list of two or more items, that word covers all of the following interpretations of the word: any of the items in the list, all of the items in the list and any combination of the items in the list, unless expressly limited to one or the other.

"Logic" refers to machine memory circuits, non transitory machine readable media, and/or circuitry which by way of its material and/or material-energy configuration comprises control and/or procedural signals, and/or settings and values (such as resistance, impedance, capacitance, inductance, current/voltage ratings, etc.), that may be applied to influence the operation of a device. Magnetic media, electronic circuits, electrical and optical memory (both volatile and nonvolatile), and firmware are examples of logic. Logic specifically excludes pure signals or software per se (however does not exclude machine memories comprising software and thereby forming configurations of matter).

Those skilled in the art will appreciate that logic may be distributed throughout one or more devices, and/or may be comprised of combinations memory, media, processing circuits and controllers, other circuits, and so on. Therefore, in the interest of clarity and correctness logic may not always be distinctly illustrated in drawings of devices and systems, although it is inherently present therein.

The techniques and procedures described herein may be implemented via logic distributed in one or more computing devices. The particular distribution and choice of logic will vary according to implementation.

Those having skill in the art will appreciate that there are various logic implementations by which processes and/or systems described herein can be effected (e.g., hardware, software, and/or firmware), and that the preferred vehicle will vary with the context in which the processes are deployed. "Software" refers to logic that may be readily readapted to different purposes (e.g. read/write volatile or nonvolatile memory or media). "Firmware" refers to logic embodied as read-only memories and/or media. Hardware refers to logic embodied as analog and/or digital circuits. If an implementer determines that speed and accuracy are paramount, the implementer may opt for a hardware and/or firmware vehicle; alternatively, if flexibility is paramount, the implementer may opt for a solely software implementation; or, yet again alternatively, the implementer may opt for some combination of hardware, software, and/or firmware. Hence, there are several possible vehicles by which the processes described herein may be effected, none of which is inherently superior to the other in that any vehicle to be utilized is a choice dependent upon the context in which the vehicle will be deployed and the specific concerns (e.g., speed, flexibility, or predictability) of the implementer, any of which may vary. Those skilled in the art will recognize that optical aspects of implementations may involve optically-oriented hardware, software, and or firmware.

The foregoing detailed description has set forth various embodiments of the devices and/or processes via the use of block diagrams, flowcharts, and/or examples. Insofar as such block diagrams, flowcharts, and/or examples contain one or more functions and/or operations, it will be understood as notorious by those within the art that each function and/or operation within such block diagrams, flowcharts, or examples can be implemented, individually and/or collectively, by a wide range of hardware, software, firmware, or virtually any combination thereof. Several portions of the subject matter described herein may be implemented via Application Specific Integrated Circuits (ASICs), Field Programmable Gate Arrays (FPGAs), digital signal processors (DSPs), or other integrated formats. However, those skilled in the art will recognize that some aspects of the embodiments disclosed herein, in whole or in part, can be equivalently implemented in standard integrated circuits, as one or more computer programs running on one or more computers (e.g., as one or more programs running on one or more computer systems), as one or more programs running on one or more processors (e.g., as one or more programs running on one or more microprocessors), as firmware, or as virtually any combination thereof, and that designing the circuitry and/or writing the code for the software and/or firmware would be well within the skill of one of skill in the art in light of this disclosure. In addition, those skilled in the art will appreciate that the mechanisms of the subject matter described herein are capable of being distributed as a program product in a variety of forms, and that an illustrative embodiment of the subject matter described herein applies equally regardless of the particular type of signal bearing media used to actually carry out the distribution. Examples of a signal bearing media include, but are not limited to, the following: recordable type media such as floppy disks, hard disk drives, CD ROMs, digital tape, flash drives, SD cards, solid state fixed or removable storage, and computer memory.

In a general sense, those skilled in the art will recognize that the various aspects described herein which can be implemented, individually and/or collectively, by a wide range of hardware, software, firmware, or any combination thereof can be viewed as being composed of various types of "circuitry." Consequently, as used herein "circuitry" includes, but is not limited to, electrical circuitry having at least one discrete electrical circuit, electrical circuitry having at least one integrated circuit, electrical circuitry having at least one application specific integrated circuit, circuitry forming a general purpose computing device configured by a computer program (e.g., a general purpose computer configured by a computer program which at least partially carries out processes and/or devices described herein, or a microprocessor configured by a computer program which at least partially carries out processes and/or devices described herein), circuitry forming a memory device (e.g., forms of random access memory), and/or circuitry forming a communications device (e.g., a modem, communications switch, or optical-electrical equipment).

Those skilled in the art will recognize that it is common within the art to describe devices and/or processes in the fashion set forth herein, and thereafter use standard engineering practices to integrate such described devices and/or processes into larger systems. That is, at least a portion of the devices and/or processes described herein can be integrated into a network processing system via a reasonable amount of experimentation.

What is claimed is:

1. A room conferencing system, comprising:

a hub comprising a plurality of sensor nodes, each sensor node comprising a sensor node camera and a sensor node processor;

a master controller operable to establish a plurality of named queues, each of the plurality of named queues associated with a proximate physical object in an area comprising the hub and detectable by the sensor node camera; and

each sensor node operable to cause the sensor node processor to:

identify a viewed physical object in a feed from the sensor node camera; and

associate the viewed physical object with one of the plurality of named queues.

2. The room conferencing system of claim **1**, further comprising:

the master controller operable to establish a master queue comprising a description of the proximate physical object.

3. The room conferencing system of claim **1**, further comprising:

the plurality of sensor nodes arranged in a plurality of rings around a perimeter of the hub.

4. The room conferencing system of claim **3**, further comprising:

the plurality of rings each comprising exactly four sensor nodes.

5. The room conferencing system of claim **3**, further comprising:

the plurality of rings each comprising exactly eight sensor nodes.

6. The room conferencing system of claim **3**, further comprising:

each sensor of a particular ring of the plurality of rings being both vertically and horizontally offset from sensors in a ring immediately above the particular ring.

7. The room conferencing system of claim **3**, further comprising:

each sensor of a particular ring of the plurality of rings being both vertically and horizontally offset from sensors in a ring immediately above the particular ring and sensors in a ring immediately below the particular ring.

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